JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXXVI NO. 13 | SAN FRANCISCO, MARCH 25, 1916 | PER COPY, 25 CENTS

FEASIBILITY OF WESTERN ELECTRO-METALLURGY.

BY DORSEY A. LYON AND ROBERT M. KEENEY.

ELECTRIC IRRIGATION PUMPING IN IDAHO.

BY W. T. WALLACE.

IDAHO PHOSPHATE RESOURCES.

BY. R. N. BELL.

THE EMPLOYEES' OBLIGATION.

MATERIALS ADVERTISED IN THIS ISSUE

Anchors
Baker-Joslyn Co.

Batteries
Edison Storage Battery Co.

Boiler Feed Water Treatment
Dearborn Chemical Co.

Brushes
National Carbon Co.

Copper Conductors
General Electric Co.

Electrical Slate
Davis Slate & Mfg. Co.

Electrical Supplies
Electrical Ry. & Mfrs. Supply Co.
Pacific States Electric Co.

Fans
Century Electric Co.

Flexible Conduit
Baker-Joslyn Co.
Sprague Electric Works.

Fuses
Economy Fuse Mfg. Co.

Heating Appliances
Simplex Electric Heating Co.

Incubators (Electric)
Electric Specialty Co.

Insulator Pins
McGlauflin Mfg. Co.

Insulators
Hemingray Glass Co.
Pierson, Roeding Co.

Lamp Standards
Pacific States Electric Co.

Motors
Wagner Electric Mfg. Co.
Fairbanks, Morse & Co.

Oil Burners
Leahy Manufacturing Co.

Piping
Pittsburg Piping & Equipment Co.

Power Plants
Chas. C. Moore & Co.

Rotary Converters
Westinghouse Electric & Mfg. Co.

Transportation
Southern Pacific Co.

Turbines
Pelton Water Wheel Co.

Washing Machines (Electric)
Hurley Machine Co.

Wire (Trolley)
"Phono," Pierson, Roeding & Co.

Wire and Cable
The Okonite Co.
Indiana Rubber Co.

LIBRARY OF CONGRESS NOISSUED MAR 30 1916 PERIODICAL

Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 9

Hard to knock 'em over!

It is not what the UNION METAL Lamp Standard did to the automobile, but the wonderful resisting power to sudden shock or jars possessed by

UNION METAL ELECTROLIERS

and so graphically shown by the picture, that has made them preferred by so many prominent central stations and municipalities thruout the entire country. Standards constructed of any other material are frequently entirely demolished as a result of such accidents.

From time to time when ornamental standards began to be a factor in better street lighting, Union Metal Lamp Standards have been eminently successful from the vital standpoint of beauty, safety, durability and economy. Steadily their leadership has become more pronounced—more widely recognized—proving a solid foundation of correct construction and enduring materials.

Submit us your street-lighting problems; expert engineer at your service.

Pacific States Electric Co.

The Modern Electrical Supply House

Distributors for the Pacific Coast

LOS ANGELES PORTLAND OAKLAND
SAN FRANCISCO SEATTLE

Union metal lamp standard in City of San Francisco after contact with an automobile. Save for the bending of the steel tie rods and several broken globes, the standard remains uninjured.

Increase your sales

with —

Electric Home Laundry Machines

The THOR No. 25 is just the size for the average family. Get in touch with us now and let show you how it will increase your profits.

Ask about our partial payment plan. It is an added inducement to offer your customers.

Service is our specialty—both to you and your customers. Every machine sold under a guarantee bond.

THOR PAT. SAFETY GUARD
PUSH BUTTON SWITCH STARTS OR STOPS MACHINE
REVERSIBLE WRINGER. WRINGS FROM EITHER SIDE. FINEST RUBBER ROLLS
BEST STEEL TENSION SPRINGS
CYLINDER OF HARD WHITE MAPLE OR COPPER
PUSH BUTTONS AND LEVERS CONVENIENTLY PLACED. ONLY TWO LEVERS ON MACHINE
COVER WHICH ALSO SERVES AS TABLE
ALL MOVING PARTS ENCLOSED
NEW TYPE MOTOR
THE ATALOG
BEAUTIFULLY ENAMELED IN WHITE
LARGE SWIVEL CASTERS WHICH MAKE IT EASY TO MOVE THE MACHINE

Our 50 page Catalog will interest every dealer, electrical contractor and central station man. Sent free upon request. Write for it today.

HURLEY MACHINE COMPANY

Chicago New York

DISTRIBUTERS FOR THE PACIFIC COAST

PACIFIC STATES ELECTRIC COMPANY

Los Angeles Oakland Portland San Francisco Seattle

MAR 28 1916 ©CLB357967

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXXVI SAN FRANCISCO, MARCH 25, 1916 NUMBER 13

[COPYRIGHT 1916 BY TECHNICAL PUBLISHING COMPANY]

FEASIBILITY OF WESTERN ELECTRO-METALLURGY

BY DORSEY A. LYON AND ROBERT M. KEENEY.

(This comprehensive summary of the status of the application of electricity to metallurgy constitutes Appendix J of the Columbia River Power Project Report, having special reference to the feasibility of employing the power to be developed at The Dalles, Oregon, for electrometallurgical work. Mr. Lyon is metallurgist with the U. S. Bureau of Mines and Mr. Keeney metallurgical engineer at Cornucopia, Ore.—The Editor.)

Introduction.

Utilization of hydroelectric power in electro-metallurgical industries may be of two kinds. The electric energy may be used to supply the heat necessary for the performance of the chemical reactions of a metallurgical process, or the electrolytic action of a direct current may be employed for extraction of metals either in a reduction process or a refining process. For the purposes of this report, which are commercial, it is well to distinguish between established industries, which are producing metals and alloys at a profit by use of the electric current, and the many processes which are either still in the experimental stage or have not even passed the paper development of a patent. That is, we consider electro-metallurgical industries as commercial operations which are now consuming large blocks of electric energy, while processes, which are not in commercial operation, are only prospective consumers. Also, owing to the difficulty and chance connected with any attempt to foresee the effect of the European war upon electro-metallurgical industries, we have felt obliged to disregard the war entirely and state our opinions regardless of the existence.

Dam Site for Proposed Columbia River Power Development.

Disregarding electrolytic refining processes, the applications of electric energy to metallurgy, when considered from a commercial viewpoint, may be classified as follows:

Industries.

Manufacture of aluminum.
Electric furnace manufacture of ferro-alloys.
Manufacture of pig iron in the electric furnace.
Manufacture of steel in the electric furnace.

Experimental Processes.

Electric furnace smelting of copper ore.
Electric furnace smelting of zinc ore.

In this report only the above industries and experimental processes will be considered as possible consumers of hydroelectric power in large quantities. Electrolytic refining processes are not classified above, as they are either so closely interwoven into a cycle of metallurgical operations as one single step as to prohibit their operation as a separate industry, or the electrolytic process is of such a small scale operation as to be unimportant as a large consumer of power. An example of the former is electrolytic refining of copper. As at present operated, the electrolytic copper refinery, while it may not be located at the copper smelter, is usually owned by a smelting company upon which it largely depends for its supply of unrefined anode copper. It has also been found advantageous to locate copper refineries near the market for refined copper, which is New York. An extreme illustration of a small scale electrolytic operation which is not worth considering as a large consumer of power is electrolytic refining of gold and silver. All of the above electro-metallurgical industries are adaptable to self-contained development in a single plant, under proper conditions. Practically none of these industries consume less than 1000 horsepower in a single installation. There are many electro-metallurgical processes in successful use for the extraction or refining of metals which do not consume large amounts of power, because the yearly yield is small, as in the case of gold and silver, or, production is reduced by the small market, for example, calcium, magnesium or bismuth. If there was a demand for them, the two former metals might be produced profitably in conjunction with the manufacture of sodium, which, while a larger consumer of power than either calcium or magnesium, is not a large consumer in comparison with other electro-metallurgical industries.

There are many electro-metallurgical processes which might be considered as possible consumers of power, but in the majority of cases they exist only in patent specifications, and with a very few exceptions have not been extensively tested by either small or large experimental work. As an immediate market for power, most of these processes are of no interest to the power producer.

Factors influencing the success of an electro-metallurgal industry. The commercial success of an electric furnace or electrolytic industry, in which the basic process employed is technically sound, may depend largely upon the following factors:

1. The market for the product;
2. The cost of electric power;
3. Freight rates;
4. Labor conditions;
5. Cost of raw materials.

Of these factors, all except the cost of electric power will influence the success of any manufacturing project to a considerable degree.

Market for the product is of equal importance to the cost of power, for if there is not a steady market for the product, permitting a profit on the investment, a low cost of power will not necessarily result in the ultimate success of the enterprise. There is only a limited market for many electro-metallurgical products, so that while a good profit might be made on paper by comparing the cost of production with the average selling price the enterprise would be a failure with a large part of its products unsold. Where market competition is strong, success, as in any line of business, would depend to a large extent upon the efficiency of operation, quality of the product, and the ability to sell the product at as low a price as any manufacturer.

Among many persons the idea prevails that the success of an electro-metallurgical enterprise depends almost entirely upon a low cost of electric power, but as previously stated, we believe that a strong market demand for the product is of equal importance to the low power rate. In general it is true that reduction processes require a very low power cost, especially operations producing a large tonnage of a comparatively cheap product which compete with combustion processes, as, for example, electric smelting of iron ore and zinc ore. On the other hand, electric furnace refining processes do not require an extremely low power cost to attain commercial success, as many electric steel furnaces are operated at a profit on a power cost of 1 cent per kilowatt hour or $65.70 per horsepower year. Few electric furnace reduction processes can operate successfully with a power cost of over 0.30 cents per kilowatt hour or $20 per horsepower year, and to be greatly assured of commercial success require a power cost of $10 to $15 per horsepower year. We wish to emphasize again the statement that the commercial success of an electro-metallurgical enterprise does not depend entirely upon the cost of power.

Freight rates have a large influence on the success of such a project, and in general it may be stated that in the western part of the United States no electro-metallurgical enterprise producing a tonnage product would stand much chance of success unless it was located within a few hundred miles of the sea coast, because of the high freight rates prevailing in the west as compared with eastern rates. The short distance to water shipment has been a large factor in the success of Norwegian and Swedish electro-metallurgical plants, as well as the works in Switzerland and the French Alps. Practically all of their product is exported to foreign countries by water, while most of their ore and coal or coke is shipped to them by sea. With the exception of an electro-metallurgical plant located to utilize some specific raw material near by, the cost of raw material will depend largely upon freight rates, for, in the majority of cases at least, the ores used must be brought from a distance.

Aluminum. The development of the present aluminum industry began in 1886 with the discovery by Hall that aluminum dissolved in a molten mixture of aluminum fluoride and the fluoride of another metal

forms an electrolyte, which may be decomposed by the electric current, giving aluminum at the cathode and oxygen at the anode. In 1887 Heroult of France patented a similar process, it being a case of simultaneous invention. The matter was settled by the company controlling the Hall patents taking the American field while the Heroult patents were uesd exclusively in Europe.

Previous to that time the small amount of aluminum made was produced by reduction of the halide salts of aluminum with metallic sodium. Reduction of alumina to aluminum with carbon is not practical, because it is necessary to let the aluminum form an alloy with some other metal, such as copper, to prevent the formation of aluminum carbide.

The remarkable growth of the aluminum industry in the United States is shown by the table of production in the United States, 1883 to 1913.

Production in Pounds of Aluminum in the United States, 1883-1913.*

1883.....	83	1894.....	550,000	1905.....	11,347,000
1884.....	150	1895.....	920,000	1906.....	14,910,000
1885.....	283	1896.....	1,300,000	1907.....	17,211,000
1886.....	3,000	1897.....	4,000,000	1908.....	11,152,000
1887.....	18,000	1898.....	5,200,000	1909.....	34,210,000
1888.....	19,000	1899.....	6,500,000	1910.....	47,734,000
1889.....	47,468	1900.....	7,150,000	1911.....	46,125,000
1890.....	61,281	1901.....	7,150,000	1912.....	65,607,000
1891.....	150,000	1902.....	7,300,000	1913.....	72,379,000
1892.....	259,885	1903.....	7,500,000		
1893.....	333,629	1904.....	8,600,000	Total.....	377,737,779

Ferro-alloys. Up to the year 1899, when the electric furnace was first used in the manufacture of ferro-alloys, all ferro-alloys were made in the blast furnace or the crucible furnace. High percentage ferromanganese was first produced at Bonn, Germany, in 1866. The crucible furnace was used for the purpose. The manufacture of ferromanganese was first conducted in the blast furnace in 1873, and at the present time practically all of the ferromanganese used in the steel industry is made in the blast furnace. In 1875 ferrosilicon containing 10 to 12 per cent silicon was made in the blast furnace. The manufacture of ferrochrome in a commercial way in the blast furnace started in 1886. Thus up to the year 1890 all ferro-alloys were made in combustion furnaces. In the blast furnace ferromanganese containing 80 per cent manganese can be readily made, but ferrosilicon produced in this way seldom contains over 12 per cent silicon, while the ferrochrome carries 30 to 40 per cent chromium.

The opportunity for improvement in the production of high grade ferro-alloys by the use of the electric furnace was made evident by the researches of Moissan, beginning in 1890, upon the reduction of metallic oxides in the electric furnace.

The commercial production of ferro-alloys in the electric furnace began in 1899 when the Bullier patents for the manufacture of calcium carbide were declared valid in France. There was also an overproduction of calcium carbide which culminated at the same time. This rendered it necessary for many established carbide works to seek new uses for their electric power and their electric furnace installations. These works began the manufacture of ferrosilicon, ferrochrome and ferromanganese in the old carbide furnaces. At that time the manufacture of ferromanganese in the electric furnace did not prove successful because of the high loss of volatilization. The production of high percentage ferrosilicon, ferrochrome and other ferro-alloys not easily volatilized was very successful.

By 1902 ferrosilicon containing 25 per cent silicon was being made in the electric furnace, and this alloy was used to a considerable extent by steel manufacturers instead of the blast furnace alloy of 10 to 12 per cent silicon. This was quickly followed by the introduction of ferrosilicon containing 50 per cent silicon. The high grade ferrochrome of 60 to 70 per cent chromium and 5 to 8 per cent carbon rapidly replaced in use the lower grade blast furnace product. Later the production of ferrochrome containing less than 1 per cent carbon was begun. As the refining possibilities and the high temperature available were more fully understood, the production of many ferro-alloys not previously manufactured was commenced.

Pig Iron. In 1898 E. Stassano of Italy experimented upon the production of steel directly from ore in the electric furnace. At about the same time other ores were being reduced in the electric furnace in the manufacture of ferro-alloys. As a result of this work, the attention of the Canadian Government was directed to the manufacture of pig iron in the electric furnace. Canada is not as well favored as the United States with abundant high grade iron ore and first class coking coal. Ultimately, through the efforts of Dr. Haanel, a commission was appointed in 1904 to investigate the different electrothermic processes employed in the smelting of iron ores and the manufacture of steel then in operation in Europe.

While the commission was at La Praz, France, Dr. Heroult demonstrated the possibility of production of pig iron from iron ore in the electric furnace. At the plant of Keller, Leleux & Co., Livet, France, further experiments were made on a larger scale. These experiments made at Livet in 1904 marked the real beginning of the present practice of reduction of iron ores in the electric furnace, for, although the furnaces in use for this purpose at present differ considerably in construction from the Keller furnace, the principle employed is the same, namely, the ore, flux and reducing agent were fed around the electrodes and the heat generated by the current passing through the charge raises the temperature of the ore and fluxes to their melting point and thus enables the carbon to reduce the ore with which it is mixed.

From the report of the commission it was evident that further work was necessary to determine the consumption of the electrical energy and electrodes, the character of ores which could be used for the production of a good grade of pig iron, and whether peat coke could be used in place of charcoal or metallurgical coke. A furnace was then built at Sault St. Marie, Ontario, and experimental work conducted for several weeks in 1906. The results of these runs showed that magnetite ores of high sulphur content could be made into a good grade of pig iron in the electric furnace; that a low grade of charcoal could be used; that peat coke could be substituted for metallurgical coke; and that titaniferous ores containing up to 5 per cent titanium could be used for the production of pig iron of marketable grade in the electric furnace. No electric furnace pig iron plants are now in operation in Canada, although one was started at

*The production of bauxite and aluminum in 1913. Mineral Resources of the U. S., 1913. U. S. Geological Survey, W. C. Phalen, p. 16.

Welland, Ontario, which was later converted into a ferrosilicon plant. This lack of plants is not, however, due to the technical or commercial failure of electric furnace reduction of iron ores, but because the economic and geographic conditions have not seemed to warrant, to the present time, the introduction of the electric furnace for the production of pig iron.

In Sweden the conditions are somewhat analogous to those found in Canada; that is, there are iron ores but no coal for coking. There is, however, this difference between the conditions in Canada and in Sweden —in Sweden, as also in California, the ores are for the most part high in their iron content and rather free from impurities. The iron industry has been established in Sweden for some hundreds of years. The ores have been smelted in a blast furnace, charcoal being used for the most part as a reducing agent, and Swedish charcoal iron is well known for its purity. For some time it has been apparent to those familiar with the situation that there would have to be some innovation in order to enable Swedish iron manufacturers to keep the cost of production down, due to the scarcity of charcoal at a reasonable price. This fact has resulted in the introduction of electric smelting in Sweden.

Some small scale experimental work resulted in larger scale work being done at the Domnarfvet Iron Works in 1907. After building several furnaces one worked successfully, and it is the forerunner of the present type of Swedish iron smelting furnace. The experimental runs conducted at Domnarfvet satisfied those interested in the work so well that it was decided to go a step farther and to construct and perfect a furnace of a size suitable for commercial purposes. This work was undertaken by the Jern-Konteret, an association of the iron masters of Sweden. This association voted $90,000 for the purpose of erecting a plant and developing the process at Trollhattan, where the Swedish government also assisted to the extent of furnishing the power at a nominal figure. Operations with this furnace were started November 15, 1910, and were continued without interruption until May 29, 1911. During these experiments the furnace smelted well from the start on various grades of ore. The furnace after some alterations was again put in operation in August, 1911, and was in continuous operation to July, 1912. As a result of the successful working of this plant, it was leased in September, 1912, to the Stromenas Iron Works which has since worked it as a commercial plant.

Simultaneously with the Swedish development of electric iron ore smelting, experimental work was conducted at Heroult, California, by the Noble Electric Steel Company under the direction of Dr. Heroult. The first furnace constructed and operated in July, 1907, appeared to be impracticable because of mechanical difficulties. A second furnace was then constructed, which was similar to the Swedish type of electric furnace, but was developed independently. This furnace proved very successful for the production of white iron, as was also the case at Trollhattan, but high carbon foundry iron could not be made. In the spring of 1911 the company decided to build a new type of furnace. Accordingly, the present type of California furnace was evolved, which has successfully produced the grade of foundry iron required by the Pacific Coast foundries, an iron high in graphitic carbon and silicon and low in other impurities.

The types of furnaces which have been developed in Sweden and California as at present constructed may be briefly distinguished by the fact that the Swedish type is of circular cross section and has a shaft, while the California furnace is of the rectangular cross section with no shaft. A furnace similar to the present type of California furnace had been previously developed in Europe by calcium carbide manufacturers, and there is now one large installation for smelting iron ore in Sweden.

(To be continued.)

SAN DIEGO COMPANY'S STOCK OFFERED LOCALLY.

Following the new policy of the Byllesby utility companies of encouraging investment by citizens of the community served, the San Diego Consolidated Gas & Electric Company is offering its new issue of $500,000 7 per cent preferred stock direct to the people of that city. The San Diego Company is a subsidiary of the Standard Gas & Electric Company, and has had a rapid and successful growth. Subscriptions for the new preferred stock issue are being received subject to the approval of the issue by the railroad commission of California. Proceeds will be used to retire $356,000 6 per cent debenture bonds due in 1922, to pay floating indebtedness, and to provide capital for extensions. The company's present capitalization consists of $4,266,000 first mortgage 5 per cent bonds due in 1939, $356,000 6 per cent debenture bonds due in 1922, and $2,955,000 common stock. The company serves 19,028 electric light and power customers and 21,462 gas customers. Its connected power load is 17,089 horsepower.

The preferred stock is being offered direct to the people of San Diego in a series of newspaper advertisements, in which the fact is brought out that the company has no difficulty in financing its requirements in the general investment markets of the country, but prefers to build up and increase home proprietorship, prefers to build up and increase home proprietorship.

The "nu" is a new unit of measurement suggested by the "Practical Engineer" as a means of reconciling the English and metric systems. It harmonizes both systems, permits of subdivisions and calculation in its own decimal units and easy conversion to either system. The proposed standard of length is 5 ft. or 60 in. It is equal to 1.524 meters; to 152.4 centimeters. This conversion factor is divisible by 2, 3 and 4, and the length in inches, 60, is divisible by 2, 3, 4, 5 and 10. While the multipliers for conversion to metric measurements look irregular, they are exact in 3 places and are immeasurably simpler than conversion from yards or feet or inches to metric units. Going to larger measurements, the mile is 1056 un. If a greater unit or gu. be taken, as 1000 nu. ,or 5000 ft., it will equal 1524 meters or 1.524 km., so that the same conversion multipliers will hold between the gu. and the kilometer as between the nu. and the meter.

ELECTRIC IRRIGATION PUMPING IN IDAHO.

By W. T. Wallace.

(Concluded.)

Use of water. It is of particular importance that the best use be made of the pumped water furnished the average pumping irrigation district. The duty of water can be greatly increased by the rotation of water among the users and by the proper selection of crops. For instance, a farmer with a 40 acre tract may have 20 inches of water at his disposal. Such an amount is too small for practical irrigation. He should have the use of two to four times this flow until his irrigation is finished, after which his water can be turned over to his neighbors who in turn will have the benefit of a practical working flow. A great waste of water occurs in many localites from the use of a flow that is entirely too small for securing economical results. Water is often allowed to run too far over the land. In many cases fields are watered for a quarter of a mile between the supply ditches. This results in an excessive watering of the upper parts of such a field, which is a great waste and often a positive detriment to the crop. The remedy lies in using a sufficient head of water to cover the land quickly and in flooding over the surface of the land for a short distance only.

An excessive acreage of alfalfa complicates the water question as it requires about twice as much water as the average crop. Corn will produce 10 to 12 tons of ensilage per acre, worth about $4.00 per ton, and requiring only an average amount of water. Corn ensilage fed with alfalfa makes a better balanced ration than alfalfa alone.

Water storage. Under ordinary conditions in this section it is advisable to have an additional supply of water for two months during the hottest of the season. While this water peak may be somewhat reduced by proper crops, water rotation and best methods of irrigation, it is difficult to avoid it entirely. It is extravagant to install additional pumping equipment for meeting this peak, as this increases the cost for power in greater proportion than the water pumped. Sometimes it is possible to provide storage water for this purpose.

The power rates given are applicable for use during the entire year. It may be advantageous to store water by pumping throughout the year, which could be used for supplying this peak demand. Suppose the system has several lifts. It might be advisable to have a storage reservoir under the higher lift which could be filled during the winter months and which would result in economy, although a certain percentage of the stored water would be lost by seepage and evaporation before the time for its use had arrived. In some cases it might be profitable to install special pumping equipment where a suitable storage site is available at a moderate increase in elevation above the higher lift. This winter storage of water is a most important point and one deserving careful consideration in laying out a pumping project. Where water is pumped to any considerable height, say from 75 to 100 ft., seepage losses assume especial importance. It is nothing unsual for a canal system to lose as much as 40 per cent of the water received at the head of the canals. Consider, for instance, a pumping plant drawing a maximum of 2500 electrical horsepower. The minimum bill on such a plant for a six months' season is $45,000. Assuming a 40 per cent seepage loss, the waste power from this source costs $18,000 per season. This is 8 per cent on a principal of $225,000. The cost of good concrete lining for a 100 second foot canal varies from $2 to $3 per lineal foot, depending on the canal section, price of materials, etc. Fourteen to twenty-one miles of such canal could be lined with this principal. While it will be impossible to prevent all seepage by lining the main canals, still this comparison shows the folly of putting expensive pumped water into ditches in poor condition. The necessity for cutting down seepage losses increases directly with the head pumped.

Requirements for Successful Pumping.

One of the fundamental differences between gravity and pumping systems is the annual cost of operation. A large gravity system is usually completed and turned over to the settlers, presumably in condition for furnishing a full water supply. The total cost lies against the land for which the system is provided and arrangements are usually made for taking up this construction charge in a long series of small payments, the first as a rule not falling due for some years. The total annual charge per acre for the first few years is interest on the bonded indebtedness plus a moderate maintenance fee, averaging from $1.00 to $1.50 per acre. Under such a system, a land owner may hold idle land for several years without being greatly burdened. The farmers who begin at once the reclaiming of their lands are furnished all of the regular water allowance and oftentimes a surplus which aids greatly in subduing raw land. The irrigation system can be operated at full capacity for practically the same cost as for partial capacity.

The pumping system, however, is subject to more severe requirements in its early years. It is impracticable to water a small percentage of the total lands scattered over the district with the same pumping charge per acre irrigated as would be necessary for watering the whole tract. This is due to the fact that seepage losses for most of the system must be supplied, although but a fraction of the water is delivered, and to the fact that the pumps working at less than their full capacity must be throttled down, which lessens their efficiency considerably. Consequently, the average pumping plant watering only a third of the land in scattered sections will require a power consumption out of all proportion to the acreage watered. This results in a heavy pumping charge falling on the idle lands which accumulates rapidly and makes it imperative that such lands begin immediately to produce returns to offset such charges. The irrigation pumping district is no proper field for a land speculator. It is important that most of the lands under pumping system should be cultivated immediately if such a project is to be successful.

Lift. Most pumping districts have several lifts in order to prevent excessive power charges. This adds to the cost of the irrigation system and greatly increases the seepage losses. A careful study and very good judgment are necessary to determine how many lifts are profitable. The total average lift in the present state of the land market should not exceed 75 to

80 ft. for large districts and should be proportionately less for small tracts, providing that the land is to be used for general farming. Some Idaho irrigation projects have been condemned at the outset by excessive lifts undertaken.

In order to make a rough comparison between the value of raw land under gravity systems and under pumping systems of various heads, suppose that the annual maintenance cost per acre is $1.25 for the gravity system and $1.50 for the pumping system; that the average cost of gravity system per acre is $30 and for pumping systems is $20; that all annual charges for water represent a principal at 9 per cent on the basis of interest at 8 per cent and taxes and insurance at 1 per cent; that the pumping system delivers 5/8 in. per acre at the pumps with an efficiency of 75 per cent based on the total head, that power is received at the minimum price of $18 per horsepower for a six months' season; and that general improvements are worth $30 per acre under both systems. These assumptions give the benefit of all doubt to the pumping system. Then, if improved land is worth $100 per acre, raw land has the following values:

Gravity System			$26 per acre
Pumping System: Total Head.....	25 ft.		24 per acre
	50 ft.		18 per acre
	75 ft.		5 per acre
	100 ft.	Minus	4 per acre
	125 ft.	"	14 per acre
	150 ft.	"	23 per acre
	175 ft.	"	33 per acre
	200 ft.	"	42 per acre

Pumping plant. The pumping plant should be designed to operate at full capacity 24 hours per day throughout the season in order to take advantage of the low power rate for such service. As previously mentioned, in connection with power rates, the advantage to the consumer of such use is great. There is opportunity for improvement in the type of motors employed. Formerly all pumping motors have been induction type having the average commercial efficiencies, which are fair for large size and high speeds, but which are low for slow speeds. The induction motor is not as efficient as the synchronous motor for sizes exceeding 100 h.p. and is at a greater disadvantage on the low speeds necessary for low lifts.

Synchronous motors have now been developed to a point where they are practically as fool proof and as satisfactory in operation as the standard induction motors. For instance, in one Idaho plant two synchronous motors were recently installed, one of 152 h.p., the other of 256 h.p., having efficiencies at full load of 94.7 per cent and 95.5 per cent respectively. The standard induction motor of the same size and speed has efficiencies of 89 per cent and 91 per cent respectively. The synchronous motor is not suitable unless an operator is in constant attendance. For large pumping plants this feature is not a drawback. The first cost of synchronous motors is slightly higher, but the saving in power consumption will pay the excess cost within two or three seasons.

Pumps. Too careful attention cannot be given to the selection of proper pumps. The centrifugal type is the standard for all lifts that are feasible in this territory. The pump as a machine should be of high grade, have renewable wearing parts, and be of such construction throughout as to maintain a high permanent efficiency at reasonable cost for renewals. It is impossible to secure any centrifugal pump which will maintain a high efficiency indefinitely. The best of runners will wear and fairly frequent replacement should be anticipated. Under ordinary conditions it is advisable to use bronze impellers, as pumps are not given the attention necessary to maintain a good efficiency with cast iron impellers. A mistake is often made in purchasing bronze impellers without specifying the composition of the bronze. The price of bronze varies according to its composition. The manufacturer may take advantage of a loose specification to supply an inferior grade. Probably standard government bronze of 88 per cent copper, 10 per cent tin and 2 per cent zinc is the most efficient material for bronze impellers.

It is vital not only that a high class pump be selected, but that it shall be suited to the conditions under which it is to operate. A pump of perfect design and construction may be abused by using under a head and at a speed for which it is unsuited, resulting in poor efficiency, and rapid cutting of the impellers. Perhaps the greatest abuse of pumps is in connection with small individual plants where no expert advice is obtained before the equipment is purchased. Plants are too often installed without accurate data as to the total effective head and other conditions are not considered which must be taken account of in securing an efficient plant.

A great advance has been made in the design of centrifugal pumps within the past three years. Manfacturers are placing a better grade of small stock pumps on the market. At present it is possible to secure such pumps with guaranteed efficiencies as high as 54 per cent for 2 inch, 62 per cent for 3 inch, 64 per cent for 4 inch, 73 per cent for 6 inch, 74 per cent for 8 inch, and 76 per cent for 10 inch.

All piping should be of ample size and all angles of long radius and as few as possible. Foot valves and all unnecessary fittings should be eliminated. If the discharge line is long it is very poor economy to assume a large friction head for the sake of a slight saving in cost of pipe.

Canal system. The canal system should be as short as possible with the number of lifts selected to insure the greatest economy. The seepage losses from numerous canals should be balanced against the extra cost of pumping into fewer canals of larger capacity with a slightly increased average lift. Liberal use of metal flumes and pipe lines should be made to avoid long detours, which add to the seepage loss and increase the pumping head. The advisability of lining the canals should be carefully studied. In many systems the saving in seepage losses would pay a handsome return on the cost of such lining especially in the larger sections of the main canals. It is poor economy to attempt to save pumping head by adopting too flat a grade for the canals. Very low velocities cause canals to become choked with silt and excessive growth of weeds which limits materially their capacity and adds greatly to the seepage loss. The additional first cost of excavating such canals is also a serious item.

Preliminary plans should be carefully drawn and a minute study made of the entire situation. The aid of a competent engineer and of a soil expert should be secured. Complete estimates of first cost and the

cost of maintenance should be made and checked with the experience of similar districts. Such results should be studied with regard to land values and probable value of crop products.

Operation. Many of our most important pumping systems, some costing over three quarters of a million dollars are turned over to the farmers for operation, none of whom may be experienced in handling a large power plant and who are skeptical as to the need of skilled attendance. The machinery is given improper attention and soon falls off in efficiency. No records are kept as to the water pumped, so that it is impossible to check the efficiencies of the plants as time goes by. No adequate accounting system is used and the cost of operating the plants and maintaining the canal system is unknown. It is wasteful to operate a property of such value under any but strictly business principles.

In private business such methods would soon end in disaster. It is not surprising that some irrigation pumping districts have made unwise expenditures and find themselves in curious situations because of ignorance as to their operating conditions.

Position of Consulting Engineers.

In no field is there an opportunity for a consulting engineer to render his clients greater service than in connection with irrigation pumping projects. While the rough investigations and calculations necessary to determine as to whether a project is feasible, are quickly and simply made, no one, as a rule, makes such estimates without the assistance of an engineer. Too often the system's main features are decided upon without the advice of the engineer and his task is to make the best of a poor proposition. Candid advice on the part of a a consulting engineer early in the procedure would often prevent serious fundamental errors.

Great pressure is often brought to bear on a designing engineer to reduce the first cost by every means possible. This results in poor economy in the long run and sometimes in disaster for the project. The engineer must often give advice which may be against his temporary interests but which will result in advancing the interests of the profession permanently. Nothing would be of greater value to this state than to have all its irrigation projects well chosen and well constructed.

Gasoline from shale in Colorado is being investigated by the U. S. Geological Survey, which estimates that in that state alone there is sufficient shale, in beds 3 ft. or more thick, to yield 20,000,000,000 barrels of crude oil from which at least 2,000,000,000 barrels of gasoline may be extracted by ordinary refining processes. The area that has been studied by the Geological Survey comprises northwestern Colorado, northeastern Utah, and southwestern Wyoming. The shale found there contains materials which, when heated, may be converted into crude oil, gas and ammonia. Sooner or later this great source of supply will be utilized to supplement the decreasing production from the regular oil fields. When refined by ordinary methods the shale oil yields an average of about 10 per cent gasoline, 35 per cent kerosene, and a large amount of paraffin.

IDAHO PHOSPHATE RESOURCES.

BY R. N. BELL.

(Details are here given of the fertilizer resources of Idaho and Montana, the paper having been presented before the seventh annual convention of the Idaho Society of Engineers at Burley, Idaho, Feb. 22, 1916. The author is state inspector of mines.—The Editor.)

The phosphate deposits of southeastern Idaho were first recognized as such about twelve years ago as the result of an advertising campaign by the officials of a prominent California smelting company, who, through the harassment of smelter smoke troubles with the local agricultural interests, was forced to reduce its sulphur fumes to sulphuric acid and in an effort to find a market for its acid production, endeavored to discover a local supply of rock phosphate, the treatment of which in the production of superphosphate, involves a heavy consumption of sulphuric acid. The result of this advertising campaign by this company brought specimens to their works of what proved to be high grade rock phosphate from northern Utah and southeastern Idaho. The best Idaho discoveries were made in Bear Lake county in the vicinity of Paris and Montpelier.

The results of these discoveries and the subsequent development and study of the field that has since ensued, has been to give to Idaho and the United States at large, what is probably the most valuable and most important mineral discovery ever made in the nation's history, as this phosphate field has proven to be of enormous extent and capacity, affording what is probably an exhaustless supply of the most vital element of soil fertility that puts this nation in an independent position of foreign source of supply for all time.

Prior to these western discoveries the total known resource of rock phosphate in the United States was largely confined to the states of Florida and Tennessee and was estimated by government geologists as having a probable life of thirty to forty years. These southeastern deposits are largely owned by foreign capital and ship more than a million tons a year of high grade rock to European markets. This situation proved of vital concern to the United States conservation advocates and there isn't any question but that they were justified in their anxiety for the future of American agriculture in this connection and they went so far as to suggest that this government put an export duty on shipments of rock phosphate from this country, but, since the western discoveries have been made and their enormous extent has been outlined, this concern of the conservationists should be dispelled.

High grade rock phosphate has a spot value at the point of production of four or five dollars per ton. The purpose for which it is used is as a fertilizer for soil and its value for that purpose will be appreciated from the following explanation. This mineral is more valuable than coal or iron, or any other substance, by reason of its primary scarcity and its essential necessity to all living organisms, and in this connection I cannot do better than to give you an appreciation of the inestimable worth of this mineral than to quote from a work entitled "The Conservation of Natural Resources in the United States" by Charles R. Van Hise, which is in part as follows:

"The last of the elements which we need to consider is phosphorus, just as we find in the arid regions that water is a crucial factor limiting production, so for the humid regions of the United States, phosphorus is the crucial limiting factor in the productivity of the soil." "Phosphorus is an essential constituent of blood and flesh and bone and brain." How essential it is has been very clearly shown by experiments which have been carried on in the Wisconsin Experiment Station following somewhat analogous experiments elsewhere. Animals have been fed with a ration deficient in phosphate with the result that these animals thrive for a time but after three months they collapse. In an intermittent stage some of them were killed and it was found that the flesh was taking the phosphate from the bone in order to supply its need. This went on until the bones were no longer able to supply phosphorus to the flesh, then the irretrievable collapse came. They could not recover when fed on normal rations."

The soil is the most vital asset of this nation, as from it all our food and clothing is derived. There are about a dozen important constituents in normal soil that supply the elements of plant growth. Most of these, however, are of minor importance and of an exhaustless nature. The three vital elements of plant food are potassium, nitrogen and phosphorus.

Mr. Cyril G. Hopkins, of the University of Illinois, one of the ablest practical soil experts in the United States, has shown that on a general average the primary virgin soils of the United States contain thirty thousand pounds of potassium, about five thousand pounds of nitrogen and about eleven hundred pounds of phosphorus in two million pounds of soil representing an acre surface to a plow shear depth of six and three quarter inches.

The normal supply of potassium is practically exhaustless in the soil. The nitrogen gives way rapidly to crop production but is four times greater in amount than the phosphorus. It is also very cheaply and easily replaced by the cultivation of legumene plants. The phosphorus, in its limited primary amount, is also rapidly used up by growing plants, especially the seed producing plants, such as wheat, corn and other grains, and the crop producing capacity of the soil is permanently reduced by the depletion of its phosphorus contents and the only possible way to supply this deficiency is to physically put back the phosphates in concentrated form upon the land. The exhaustion of this vital soluble salt of vegetation by single and constant cropping without refertilizing has resulted in the agricultural abandonment of millions of acres of formerly fertile land in the original thirteen states and this deterioration in crop producing capacity is rapidly extending westward has crossed the Mississippi River a long distance in some directions.

Hence, it will be appreciated that our rich western field of highly concentrated phosphate mineral must soon find a rapidly expanding market in the prairie states of the middle west, to which it is geographically as conveniently located as are the present sources of supply in the southeastern states.

The American farmer does a great deal of boasting about the wonderful annual crop production that is made, but as a matter of fact on the average he is a soil pirate and robber who gives little regard to the fact that he is living on his principal and rapidly deteriorating the basic value of his land. This fact is illustrated by the experience of European agriculture. The United States census records will show that the average acre yield of wheat for the past thirty years in the United States will not exceed fourteen bushels per acre and all other grains in proportion, and this in spite of the fact that during that period, hundreds of millions of acres of virgin soil has been put under the plow.

On the other hand in several European countries, under less favorable climatic conditions, the acre yield of grain where intelligent regard for proper soil fertilization is in force, exceeds the United States' average by from one hundred to two hundred per cent. These facts present a big subject for the serious consideration of our National Department of Agriculture, as there isn't any question that by intelligent regard for the renewal and conservation of soil fertility, the total agricultural production of this nation can be doubled from the present cultivated area, a result that would materially reduce the present cost of living and multiply by several times, the basic value of rural credits and is a consummation devotedly to be wished.

The Idaho phosphate deposits resemble coal veins. They occur in a series of shales and thin bedded lime stones of middle carboniferous age. The phosphate series proper is from sixty to two hundred feet thick and is overlaid by heavy bedded limestone formations and underlaid by heavy bedded limestone and sandstone formations. The phosphate series and the immediately overlying formations are readily identified by a conspicuous association of fossil shells and can be followed by reason of these identification marks, through hundreds of miles of duplicated outcrops by reason of the folded and faulted condition of the beds in a mountain region forty miles broad, east and west, by one hundred and forty miles long, north and south, covering a large portion of six of the southeastern Idaho counties, extending from Bear Lake to Fremont.

The deposits occur as beds or veins standing at all angles in the formation from flat to vertical. The outcrops present a brown shaly blossom but at a short distance under ground the mineral is black and has a decidedly volitic texture like the roe of a fish. It is clean ore, a little heavier than the enclosing wall rock and is cheaply mined by the same methods, using the same tools and at about the same cost per ton as bituminous coal veins and requires no subsequent washing or mechanical concentration.

The principal high grade bed of the series, carries an average value of 70 per cent tri-calcium phosphate and an average width of 5 to 7 ft. In addition to this bed the shaly cross section of the phosphate formation at the Georgetown canyon group in Bear Lake county, owned by the Utah Fertilizer and Chemical Company, carries eight super-imposed beds of rock phosphate varying in average value from forty-three to seventy-five per cent tri-calcium phosphate and varying in thickness from three to twelve feet.

This remarkable cross section of the series, which is considered the maximum of value by the United States Geologists, contains 68 ft. of rock phosphate in thickness which shows an average value of nearly 60 per cent and represents a phenomenal resource of second grade rock of superior value to what is gladly used by the Russian farmer, who is well satisfied to get a fifty per cent rock phosphate in the fertilization of his soil.

The United States government has issued a series of bulletins on the Idaho part of this remarkable mineral field, and in their most recent bulletin, No. 577, by Richards and Mansfield, a final summary of the Idaho portion of the phosphate field they have covered in detail, gives an estimated resource of 2,666,290,000 tons. This estimate is based on a mineable depth of 2000 ft. below the outcrop of the beds, and these experts make no effort to estimate the enormous resource of lower grade material, ranging from 35 to 65 per cent.

Their assumption of a mineable depth of 2000 ft. is extremely conservative, as will be appreciated from the fact that just over the Wyoming line at Rock Springs, actual coal mining operations have been followed to a depth of 6000 ft. in the much softer and more flexible cretaceous shales and sand stones. The wall rocks of these phosphate beds in their more ancient sedimentary environments are much tougher and better adapted for underground mining operations than are the more recent coal formations and there isn't any question in my mind but that the phosphate deposits can be followed to an equal depth with the coal deposits of the Wyoming mines which would mean probably three times the resource estimated by the government geologists in the territory they have covered. Add to this, the fact that the Idaho part of the field hasn't been more that half covered by detail survey, and my personal knowledge of cross section exposures of the series fully as rich as the disclosures at Georgetown, a hundred miles north of that point, and I think it is a conservative estimate to say that the Idaho part of this great western phosphate field will contain fully ten billion tons of rock phosphate containing an average value of 70 per cent or better, and of the second grade rock about 50 per cent, probably one hundred billion tons in addition.

These deposits are known to extend for hundreds of miles north along the western border of Wyoming and to continue northwest into Montana as far as the main line of the Northern Pacific Railway at Garrison and also for some distance south of Idaho well into Utah and it is not unlikely that my estimates of the Idaho resources will be duplicated in the other states mentioned when the field has been fully surveyed.

The present method of using rock phosphate that is most popular is to saturate the fine ground raw rock with an equal weight of sulphuric acid which reduces the phosphatic contents to a soluble form and makes it immediately available as plant food when applied to the soil. There is at this time three hundred million dollars invested in the manufacture of mineral fertilizer in the southeastern states. These large investments have been largely supplied by foreign capitalists and this great industry is based on the ownership of phosphate deposits and makes a product that is designated at 2-8-2, which means that it contains 8 per cent phosphorus, 2 per cent potassium and 2 per cent nitrogen in soluble form, the bulk or substance of the product or carrier being common soil.

This dominant industry deprecates the use of phosphate in any other form but it has been absolutely demonstrated that the raw rock, ground extremely fine, to the consistency of Portland cement, and applied directly to the soil in conjunction with the intelligent system of crop rotation, including the growing of leguminous crops, plowing under an occasion crop of this class, with other waste crop residues, to supply humus and humic acid in the soil, that the finely ground raw rock phosphate will become available naturally and by this method the farmer can supply and make available, the requirements of his soil in phosphatic contents for one-third the cost of the concentrated form.

Mr. Cyril G. Hopkins, of the University of Illinois has gone into this subject in detail, and has demonstrated by repeated experiments over a series of years at the Illinois station, and cites a dozen other state experiment station experiences along the same line, that demonstrate that finely ground raw rock phosphate is all the farmer needs in addition to what is already available to his hands, to bring his depleted soil back to its primary fertility and productive capacity.

Mr. Hopkins illustrates an example in Illinois, where the use of raw rock phosphate has increased crop yields on depleted soil that would hardly reproduce the seed put on it, to the highest degree of maximum production and showing a profit of from four to eight hundred per cent over the cost of the phosphate used and the other contingent labor involved in increased crop production, and his story of the soil "The Farm that Won't Wear Out" and other books and pamphlets he has published and cited can be studied with interest and profit by any intelligent farmer as they go plainly into the basic laws of profitable crop production and maximum yields.

At the present time the greatest drawback to the introduction and use of the Idaho phosphate deposits is the transportation cost to available markets and the general idea that it is necessary to transform the rock into superphosphate by the costly acid process previously referred to. A campaign of education along this line will, however, I believe, open up a big market for this mineral in the Mississippi Valley states and the history of agriculture in this and other countries make the prospects of a big industry based on the development of these deposits, inevitable and with proper encouragement could be rapidly brought to a point of active production, as it has been found that the mineral can be mined and ground to a 100 mesh size and laid down at Missouri River points at a total cost of not to exceed $10 per ton and probably for $8, and at such a charge the farmer who is now getting a result of ten to twenty bushels of wheat per acre and twenty to twenty-five bushels of corn—from the same seed and little more labor can double his yield at less than half the cost of the increase and rapidly magnify the basic value of his land as a consequence, and a well scattered demonstration of these results in the Mississippi Valley states would doubtless stimulate a decided interest in the phosphate industry of Idaho, which I believe, is destined to become as important as that which now forms the basis of such large capital investments in Tennessee and Florida.

There is a general impression among agricultural authorities in the older states, that livestock farming is essential and must be adapted for the maintenance of fertility on all farms for the value of the manure fertilier it produces, which is admittedly rich in both humus and the essential soluble salts of vegetation, but

how inadequate such a system of permanent soil fertility would be, is illustrated by Hopkins in the following statement. "Attention should be called to the fact that there are nine hundred million acres of farm land in the United States and only ninety million head of livestock equivalent to cows, including all farm animals. Will the manure from one cow serve to enrich ten acres of land? It should also be appreciated that one hundred bushels of grain will supply five times as many people as could live for the same length of time on meat and milk that could be made by feeding the grain to domestic animals. It is because of this fact that the consumer may sometimes boycott meat or other animal produce while he never boycotts bread, but let us hope that permanent systems of agriculture will become adopted in America for the production of both grain and livestock so that high standards of living may be maintained for all classes of people in this country."

In addition to the prospect of marketing our phosphate mineral in the finely ground raw state, it has been suggested by eminent chemists and in fact the subject was discussed in a recent paper by the last bulletin of the American Institute of Mining Engineers, that ammonia phosphate by electric heat may be made with waste furnace gases which might be utilized in this connection and a concentrated product of phosphorus produced at a cost of ten or twelve dollars per ton which would have a value of over a hundred dollars per ton and would stand transportation charges to any market.

In connection with the discussion of a complete fertilizer industry in Idaho, the recent discoveries of potassium and sodium salts in the southwestern corner of the state, are worthy of mention and are likely to afford a source of supply for the other elements of complete fertilizer that are used in the big fertilizer industries of the southeastern states.

These sodium and potassium deposits occur in a series of lake bed and ash bed formations in Owyhee county, Idaho, and border the base of the Owyhee range in Idaho and eastern Oregon. In this region there has been hundreds of claims located recently and the shallow development that has been put on them so far has disclosed some interesting conditions. In one instance a bed of amorphous silica resembling a sandy sediment that is thirty feet thick containing an average of 3 per cent water soluble potassium sulphate.

At other points rich sodium nitrate salts have also been found. These soluble salts are believed by Boise chemists, who have studied them, to have resulted from volcanic or solfateric action on the normal silicates of potassium and sodium for which the Owyhee range formations are noted and the prospects are very encouraging at this time for the southwestern Idaho field to provide available resources of these valuable salts.

The complete fertilizer industry of the southeastern states turn out a hundred and twenty million dollars' worth of product a year with a rapidly expanding annual yield and its duplication in Idaho is an industrial asset for this state worth figuring for and encouraging by every possible means.

The federal government has a million acres of the rich phosphate lands of southeastern Idaho withdrawn from any form of entry and a tentative blanket withdrawal on any new discoveries, and our bureaucratic national overseers at Washington, in the face of constitutional law to the contrary, seem determined to make their tenure of title to this great natural asset of Idaho permanent, and only permit its development under an exacting red tape royalty leasing system—to the detriment of Idaho's industrial progress and in the interests of the vested interests of the southeastern states and of the market of phosphate bearing converter slags, carrying less than half the value in phosphorus of the billions of tons of our lower grade rock phosphate deposits.

The Idaho phosphate deposits are of such a nature that the ore of the richer beds can be completely removed by an intelligent system of practical mining and their operation does not need the petty red tape restrictions that a federal tribute leasing system must inevitably involve in competition with the free sovereign rights of the privately owned deposits in the south. If our resources of this mineral were limited by millions of tons, as those of the southern states are, we could with more grace and in patriotic national interest, submit to their conservation and restricted use, but, with a resource that can be figured in billions of tons, a practically exhaustless supply substantially protected against export by competitive railway rates, a most liberal policy and encouragement of its use by the government and in the specific interest of the state of its origin is warranted, and the national agricultural department could profitably set aside half of its great annual outlay in bringing the nation's average annual crop yield up 100 per cent, reducing the cost of living and increasing the basis of rural credits in land values several hundred per cent, a consummation eminently possible and whose basic crucial element of success is now lying dormant in Idaho's great phosphate resources.

Wireless communication with Tahiti has been possible since Dec. 28, 1915, when the radio station erected by the French Government was opened. Communication with the United States is via Samoa and Awanui, New Zealand, thence by cable to San Francisco. The rates have not yet been established nor has the station been assigned call letters. All messages during the duration of the war must be in French or, if in English, should be accompanied with the translation. A strict censorship is exercised and code messages are not accepted. It is expected that the cost per word to the United States via the route indicated above will be over $1, and it is hoped that some arrangement may be made to transmit messages via Tutuila to Honolulu and thence to San Francisco. The all-wireless route just referred to would reduce the cost per word more than half and would insure a saving of time. The present installation of 10 kilowatt, with a wave length of 600 meters, can easily maintain communication with Tutuila. After the completion of the larger station of 300 kilowatt, and a wave length of 2500 meters, direct communication with Honolulu will be easily maintained, and even San Francisco, Sydney, and the French West Indies are expected to be reached.

THE EMPLOYEES' OBLIGATION.

The duty and obligation of an employee, to the employer, to the employment and to the dependent public; the attitude of the employer towards those duties and obligations; the effect that attitude may have upon the employment, on the service or on the public served, are vital public questions.

Whatever may be the facts with ordinary industrials, the position of the employees of public service enterprises, particularly those of transportation and intercommunication, is as distinct and separate from that of the employees of an ordinary industrial, as the position of any public service enterprise is distinct and separate from that of an ordinary industrial enterprise.

Public service employees, nominally the employees or servers of the corporation, are the employees or servers of the public. It is the "service," not of any particular employee but of every employee, that the public pays for. Service is rendered by the employee directly to the individual. The quality of the service rendered depends upon the interest of the employee in the service and the attitude toward the public. Employees who come in direct contact with the public can, in whole or in part, nullify or make objectionably inferior the efforts or service of the best organized and most comprehensive system or of the most efficient methods. No system can give good service, unless there be a direct recognition on the part of the employee that he has a duty and obligation to the public served; and following that duty and obligation, there must be some accountability of some kind to someone, if that obligation is evaded and the service is not rendered in the way it could and should be.

Good service requires expertness, which can only come from experience acquired through continuity in position; it requires efficient system and method, enforced and carried out; it requires not the servile, but the respectful and implicit subordination of the employee to the system, the method, and necessarily to the officials of the organization; it depends upon co-operation and the co-ordination of the efforts of all, employer and employee.

Continuity of service requires at all times a sufficient number of trained employees to take care of the demands of the service, and it should be beyond the power of any part of the organization to lightly cast aside even an implied obligation.

There are two "parties" in all public service—the organization with its plant and facilities for giving service, and the employees who give the service. The employee is by tradition regarded as a part of the organization and subject to its discipline and control. To a certain degree in some cases this has been nullified by combination. If this combination or the possibility of it is to be admitted, then so far as is necessary to preserve the right of the public to a continuous and dependable service, it should be under the same control and regulation by the same bodies that the corporation itself is under.

If the fundamental laws would permit it and public sentiment could be created to enforce it, it would be very desirable to work out some practical plan to accomplish this result.

"Public services" are of such a nature as to create a dependency upon some one system. It is impossible to suspend or interrupt these services even temporarily without putting the public to great inconvenience and to much suffering. To cripple or destroy such services or the means or facilities for rendering such service would be a calamity, something that nothing could justify. The obligation on the system to give a continuity of service is so strong that no excuse except force majeure can be recognized. No argument or accumulation of causes could possibly justify those, who in any way controlled the situation, in doing anything either wilfully or through negligence which would result in suspension or interference with service.

Conversely, if employees are to be controlled they should also be protected. What, then, is the method of protection? In the past, boards of arbitration have been a resort when matters have come to an impasse. Special and independent arbitration bodies are temporary, do not possess and cannot appreciate all the factors, and what is most important, have no responsibility for the effects of their decision on other interests.

To adjust properly any question involving expenditure for any part, every factor in connection with the whole business should be considered—the revenue, costs or charges, and everything that affects these. This can only properly be done by one and the same body, which must have jurisdiction over all factors involved—and therefore the only logical body to regulate and protect public service employees is that which regulates the "public utility" itself and has the responsibility to the public for this regulation.

On the other hand, it is both unreasonable and impossible to expect the employee to admit or appreciate this unless at the same time the individuals of the public recognize and observe their obligation or duty towards these employees. Courtesy on the part of the public is too often overlooked or forgotten, and too often the public fail to recognize in their bearing and action towards these employees any direct relation or any of those obligations which all employers should have towards those who serve them, and towards those who are, at least for the moment, in a subordinate position. Too often the attitude of those demanding service towards the employees giving them service, is in unreasonable and undignified contrast to that which they should give and which they do give to the employees of their immediate personal establishments.—Annual Report American Telephone & Telegraph Co.

Electric heating of office buildings has been successfully accomplished by the Washington Water Power Company in the case of its four-story building in Spokane during the past three years. Cartridge heating units are employed in a special boiler supplying steam and ordinary steam radiators. A large substation building is to be similarly heated, using the existing plant with the substitution of electric heaters for coal fuel, the hot air being circulated through the boiler tubes by means of an electric fan. No determination of rates for commercial service has yet been made.

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each,	.25

NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

CONTENTS

Feasibility of Western Electric Metallurgy 237
By Dorsey A. Lyon and Robert M. Keeney.

San Diego Company's Stock Offered Locally 240

The "Nu" 240

Electric Irrigation Pumping in Idaho 241
By W. T. Wallace.

Gasoline from Shale 243

Idaho Phosphate Resources 243
By R. N. Bell.

Wireless Communication with Tahiti 246

The Employees' Obligation 247

Electric Heating of Office Buildings 247

Editorial 248
Stabilizing an Industry.
Safe Absorption of Industrial Transients.
Factors of Assurance.

Personals 250

Obituary 250

Trade Notes 250

Meeting Notices 251
San Francisco Section A. I. E. E.
Los Angeles Section A. I. E. E.
Portland Section A. I. E. E. and N. E. L. A.
San Francisco Electrical Development and Jovian League.

Application to California Water Commission 252

News of Oregon Public Service Commission 252

Books Reviewed 252

News Notes 253

Stabilizing an Industry

The weakness of the electrical business seems to lie in its very foundation, among the thousands of dealers, salesmen and others who come in direct contact with the public. These public contactors are uninformed as to how to handle people. Nor is this otherwise than would naturally be expected, considering the newness of the electrical business. Much may be learned by studying older lines of trade which have passed through the chrysalis stage.

Consider the druggist, who stands in much the same relation to medical science, as does the dealer to electrical science. First he was technically informed, then he was licensed to dispense products which, while most beneficial, may also be most dangerous to life, and finally he has learned how to sell his wares to the public.

It is this last step that the electrical contractor is weak and consequently the entire structure of the electrical business is weakened. Electrical contractors who are dealers do not understand how to sell their wares to the public.

As a result, the central stations, sometimes unwillingly, have been put to the necessity of selling current consuming devices in order that proper and sufficient appliances be put on their lines. Frequently have they signified their willingness to give up this selling task, and frequently have they been forced to resume the practice because of the inability of the electrical dealer to sell appliances. The greatest fault in the electrical business today is that the majority of dealers do not know how to sell.

Then again it is customary to decry the competition of department stores, without sensing the fact that the day of the department store is rapidly passing and that the specialty shop is again coming into its own. The electrical business is pre-eminently one calling for specialized knowledge and the same motive that induces a woman to patronize an exclusive waist shop or a man to buy his hats or shoes at a specialty shop should be appealed to by electrical merchants.

Good customers are lost by poor salesmen every day. A man may enter a store to buy lamps because he needs them. He is confronted by a mere order-taker—the undertaker of unsuccessful business. No effort is made to sell him an electric iron, toaster, or perculator, though his house is wired, otherwise he would not be buying lamps. The spirit of service is lacking in most electric shops. Such inattention, discourtesy and crass ignorance drives away trade.

Would that most electrical dealers could see themselves as their customers see them—through their front windows. Dead flies, cobwebs and dirt have destroyed their usefulness, even as holes to let in light. This window space is a dealers' best display stand. The more thought and care expended in proper window dressing the more people who will be brought into the store to buy. This is only one phase of advertising, concerning which the electrical dealer seems to know little or nothing. Newspaper display and direct circularization as selling aids are as a sealed book to him.

The task of teaching the dealer approved merchandising methods has lately been assumed by the jobber and the jobber's salesman. The jobber has been impressed with the fact that in order for him to sell more goods the dealer should understand how to dispose of what he has already bought. He realizes that it is to his benefit, primarily, not to sell supplies but to teach dealers how to sell them profitably.

Closely identified with the difficulty in teaching the dealer how to sell goods is the problem of teaching him a realization of the meaning of costs. Since prices are being continually reduced by competition profit can come only from cutting costs faster than competition lowers prices. Nor is knowledge of how to reduce costs a secret to be jealously guarded for fear that one's competitor may learn. This is a case when the more widely knowledge is disseminated the more generally will business benefit. Ignorance of costs is responsible for most of the ruinously low bids that are made. Not only does the low bidder lose money, but also he who bids at a price that affords a fair profit.

With a more general appreciation of these facts will come a greater stability to the electrical business. Far sighted men of affairs are now bending every effort to improve conditions, not so much from an altruistic spirit, but in the belief that it is only by helping others that they can help themselves.

Safe Absorption of Industrial Transients

The very suddenness of the prosperity which has recently come to many lines of American business has brought certain embarrassments which, like the transient phenomena accompanying any rapid adjustment of stored energy, require attention in order that they may not destroy, or at least seriously cripple, the industry so benefitted. The master hand of fate has closed the switch throwing heavy surges of high voltage business into unprotected lines. Violent oscillations have been set up as a result of this change in circuit conditions, wherein potential energy has been instantaneously made kinetic. Destruction can be obviated only by a rapid absorption of the transferred energy by some safe medium.

This analogy between electrical and industrial transients, is more than a chance comparison. The phenomena are like the sudden acceleration of a moving column of water in a penstock or the rapid change of motion in any moving body. Some cushioning means, some method of energy absorption, should be provided if damage is to be avoided.

There is yet time to take thought, to give philosophic consideration to the future of our financial war brides and their war babies as well as to the more legitimate offspring. As the country was unprepared for profits, the new energy is in danger of dissipation. The net earnings of many a concern for 1916 will be as large as the gross earnings for 1915. One motor manufacturer has sold more motors during the first quarter of this year than during all of last year.

To translate these extraordinary profit into terms of transient value would bring a period of wild speculation. Would it not be better to safeguard the future by dealing intelligently with the present? Capitalization of present profits by issuing new shares to absorb them is unsafe because this kind of business is not permanent. It is purely ephemeral. Far better would it be to mobilize reserves against unknown future conditions. Fate will as inevitably open the switch as suddenly as she closed it. Equally violent oscillations in value will occur, as has occurred, in these transient "imaginaries."

But those corporations that use these profits in a permanent way, in retiring bonds, in making needed plant additions and in writing off intangible assets, will add to the real wealth of the country. While such dividends as are declared will undoubtedly be used in speculation this will promote new developments in railroads and other public utilities and will thus advance the general welfare. Just as the transient term is essential to the operation of alternating current rectifying apparatus, so it can be made of permanent value if rightly applied. But first is it advisable to convert our temporary prosperous condition into tangible present value, lest like the evanescent hues of the sunset, it vanishes even while we gaze.

Factors of Assurance

The ordinary factor of safety is an anachronism which should be no longer sanctioned among intelligent engineers. It is a relic of the time when one man's guess was as good as the next. This was before many of the fundamental laws of engineering design had been formulated, when empirical rules were in vogue and rule of thumb common practice.

Now conditions are different. Precise, rational formulas have been developed, standards have been established and records have been kept, so that it is possible to accurately predict the behavior of materials under compression, tension or shear. Instead of building a structure to withstand assumed stresses whose real values were not known, and then arbitrarily increasing the dimensions five or six times to care for unforseen contingencies, the design is now based upon known strength of materials and with a knowledge of the exact stresses which will be met in extreme cases. Judgment predicated upon statistics of past experience will determine limiting conditions to be provided for.

The factor of safety was originally adopted as an allowance for error and was thus in reality, a "factor of ignorance." It has been repeatedly demonstrated by actual test that supposedly safe factors were not sufficiently high and that the only safe method is to base design upon analysis. On the other hand clumsy designs have been replaced by logical ones, so that no excess of material adds unnecessarily to the cost. With the elimination of the several elements of uncertainty it is possible to allow simply a factor of assurance. This may be greater or less than the old factor of safety, depending upon conditions.

PERSONALS

S. K. Colby, assistant general sales manager Aluminum Company of America, is at San Francisco.

H. S. Whiting, vice-president Pierson, Roeding & Co., has returned to San Francisco from Seattle.

B. A. Wagner, general manager Electrical Agencies Company, has returned to San Francisco from Los Angeles.

Allen G. Jones, sales engineer with the San Francisco office of the General Electric Company, is at Schenectady.

C. W. Tank, general director of sales for the Fairbanks-Morse Company of Chicago, is a recent visitor at San Francisco.

A. H. Noyes, salesman Electric Appliance Company, has returned to San Francisco from Oregon and Northern California.

H. Jankelson, treasurer-manager Incandescent Supply Company, San Francisco, expects to leave for the East shortly.

L. L. Pratt sales engineer for C. H. Wheeler Manufacturing Company, has returned to Philadelphia, after a brief visit to the Pacific Coast.

A. G. Wishon, general manager of the San Joaquin Light & Power Company of Fresno, spent a few days the latter part of the week at San Francisco.

A. S. Lindstrom, Pacific Coast representative Thordarson Transformer Company, has returned to San Francisco from a three weeks trip throughout Southern California.

B. H. Scranton, president of the American Electrical Heater Company, and **Eph. Doherty,** special representative, have returned to Detroit after an extended visit to California.

Mark Ryan, city electrician and electrical dealer at Redwood City, who was the victim of a recent automobile accident, has recovered sufficiently to be able to spend a few days at San Francisco.

C. G. A. Baker, vice-president and treasurer of Baker-Joslyn Company, has returned from a trip into the northwestern territory, having spent about a week at the Seattle branch of his company.

Ed. Y. Porter, formerly employed as a valuation engineer by the California Railroad Commission, has recently been appointed distribution engineer for the Southern Sierras Power Company at Riverside, Cal.

M. L. Joslyn, president of Joslyn Manufacturing & Supply Company, Chicago, and president of Baker-Joslyn Company, San Francisco, is expected to arrive in San Francisco this week from a trip to Honolulu.

Orton E. Goodwin, a former publicity man of Portland, has been appointed California manager for the American Valveless Pump Company of Portland and will establish headquarters at Los Angeles.

L. A. McArthur, assistant general manager of the Pacific Power & Light Company of Portland, recently addressed the engineering students of the Oregon Agricultural College on the subject of "Utility Economics."

R. H. Davis, salesman of appliances, Washington Water Power Company, Spokane, Wash.; **C. F. Dobson,** operator Great Falls Power Company, Great Falls, Mont.; **John Jay Donnohue,** power department, Utah Power & Light Company, Salt Lake City, Utah; **Ronald C. Griffin,** office assistant to superintendent of electrical distribution, Pacific Gas & Electric Company, Oakland, Cal.; **Arnold Keller,** power house foreman, Cornucopia Mines Company, Cornucopia, Ore.; **L. C. Lull, Jr.,** clerk, Pacific Light & Power Corporation, Los Angeles, Cal., and **Rupert Wall,** foreman Brighton Substation, Great Western Power Company, Sacramento, Cal., have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY.

Robert M. Jones, well known engineer of Denver, Colorado, died March 1st at Carlsbad, N. W. Mr. Jones was born in Wayne, Ohio in 1853 and began his engineering career as a U. S. Deputy Surveyor in locating township and territorial boundaries, principally in New Mexico, Indian Territory and Wyoming. For this work, in 1880, he applied the Burt solar attachment to the engineers' transit and patented the Jones Latitude Arc for observing latitude at any time of day, and this was required, for a number of years on instruments used on important Government surveys.

In 1883 he associated with the Edison Electric Illuminating Company and built a steam plant at Laramie, Wyo., the second Edison three-wire system central station in the United States, and third in earning capacity of all plants built at that time. Following this hebuilt over a dozen such plants in surrounding states. He also built and operated the first electrically driven flour mill.

Mr. Jones was a pioneer in electric street railway work. In 1889 he went to Salt Lake City and built under contract the three original systems and a steam power plant there, and two electric railway systems in Montana. On account of the then undeveloped state of the industry, he devised and patented numerous appliances for this work, many of which are still in use. He then established an electrical contracting and supply business, representing the Sprague and Edison General Electric Companies. During the 1893 panic he financed and began constructing the Big Cottonwood "Stairs" hydroelectric plant to supply water to Salt Lake City. This plant was followed by the "Jordan Narrows" plant south of Salt Lake City and the plant of the Pikes Peak Power Company, supplying power to Victor and Cripple Creek, Colorado. He located and partially constructed the first plant of the Nevada-California Power Company on Bishop Creek, California, for supplying power to the Goldfield and Tonopah mining districts in Nevada. This was followed by the plant of the Black Hills Traction Company at Spearfish, S. D., the first installation in this country using the double-discharge type Francis turbines. For several years he has given much of his time to the development of a process for making hollow reinforced concrete poles, piles and pipe without the use of forms. At the time of his death Mr. Jones was engaged in making repairs on the Tansill dam on the Pecos River at Carlsbad. He leaves a widow and five sons, Barton M., Robert L., Kirby V., Paul W., and Allan B. Jones.

TRADE NOTES.

The General Electric Company has been given a contract to furnish 24 ornamental street-lighting arc lamps at Red Bluff, Calif., and 35 units for installation at Gilroy, Calif.

The officers of the Washington Association of Electrical Contractors and Dealers, recently organized at Seattle, are: W. M. McKenny, president; H. A. Wilson, vice-president, and H. D. Allison, secretary-treasurer.

Butte Engineering Company of San Francisco has closed a contract for the City and County Hospital, wiring, signal system and special apparatus, amounting to $25,750. This company is at this time developing electrical temperature regulator for pasteurizing milk.

Morrison Electric Company of Portland are making a very complete electrical installation in the J. H. Henry residence on Westover Terrace, including many novel and up-to-date electrical conveniences. They also have secured the contract for the electrical work in the new Friedman building at Ninth and Davis streets; lighting fixtures for the Masonic Temple at Heppner, Oregon; electrical work in the new Garage building at Thirty-seventh and Belmont streets and are doing the electrical lighting for Rosenblatt's new store.

MEETING NOTICES.

San Francisco Section A. I. E. E.

Prof. Harris J. Ryan will discuss "Transmission Line and Insulator Losses at Extremely High Voltages" at the March 31st meeting, 8 p. m., Engineers' Club. The paper will be illustrated with lantern slides.

Los Angeles Section A. I. E. E.

At the March 21st meeting Dr. Arthur E. King, physisist of the Mt. Wilson Solar Observatory, spoke on the relation of electrical engineering to the problems of the observatory, illustrating his address with some interesting lantern slides.

Portland Section A. I. E. E. and N. E. L. A.

The regular weekly luncheon was held March 15th at Christopher's, with one hundred and five members present. L. S. Granger, with Fairbanks-Morse Company, chairman of the day, introduced Michael F. Shannon, exalted ruler B. P. O. E. No. 99 and former deputy district attorney. He talked on the life of St. Patrick, the patron saint of Ireland, and told from history and legend, some very interesting stories about Ireland and the Irish people. A couple of real darky minstrels played ragtime and sang character songs.

San Francisco Electrical Development and Jovian League.

The March 15th luncheon, with Vice-President C. C. Hillis at the helm, transacted some little business, in addition to the entertainment features. The executive committee was instructed to endeavor to have two more inspectors put on in the Department of Electricity, as contractors were at present being held up by delay in getting permits. H. V. Carter and J. W. Redpatch were named as a committee to draw up suitable memorial regarding Frank J. Symmes. C. E. Wiggin, as chairman of the day, then introduced J. B. McCargar, assistant cashier of the Crocker National Bank, who gave an extended address denouncing plans for governmental aid in extending rural credits.

San Francisco Jovian Smoker.

A smoker and joviation have been arranged for by Tribune Murray Orrick and E. A. Wilcox to be held at San Francisco on the evening of April 6th.

Some astounding entertainment features have been planned and a good time is assured all who attend. All electrical men are invited, irrespective of whether they are members of the Jovian Order. The following committees have the affair in charge. Arrangements, A. H. Halloran, W. W. Briggs, James Barry; Entertainment, R. E. Fisher, A. E. Drendell, F. H. Poss; Refreshments, Wm. Neelands; Financial A. E. Rowe, E. A. Wilcox; Gate Prize, Albert Meinema, Hal Lauritzen, Secretary H. E. Bittman.

Portland Section A. I. E. E. and N. E. L. A.

The bi-weekly luncheon was held Thursday, March 16th, at the Portland Commercial Club. A. C. McMicken acted as chairman, and announced that from this date on the programmes would be rotated between various organizations represented in the Luncheon Club. The next luncheon will be under the auspices of the Southern Pacific Company. The speaker of the day was Captain Heggeman of the U.S.A., who spoke on "The military policy of the United States." Captain Heggeman pointed out that we never have had any military policy and that our wars cost a great deal more than if we had been adequately prepared at all times. Many times the wars would have been avoided or shortened materially by having had a trained army; volunteer armies cost more for pensions than the wars cost originally in the United States. The United States is rich in military resources but weak in having a system to assembly same for use as a defensive weapon. He also told how nearly every president of the United States from Washington to Wilson had called the nation's attention to the criminal neglect of Congress in not establishing a definite and sane military policy for defense of the country. The regular monthly meeting of the joint sections of the A. I. E. E. and N. E. L. A. will be held in the Electric Building at 8:15 p. m., April 11, 1916.

PORTLAND A. I. E. E. AND N. E. L. A. SECTION

The regular monthly meeting was held in the Electric Building, Tuesday evening, March 7. The chairman of the evening was Mr. Paul Lebenbaum. Gibson, of Forster-Gibson Co., had a series of films and slides depicting the utilization of electric vehicles, which he explained. E. M. Cutting, Pacific Coast manager of the Edison Storage Battery Co., made a few remarks, stating that he thought that the electrical vehicle associations should combine with the N. E. L. A. The paper of the evening was delivered by Dr. Morgan of Reed College on "Why America Cannot Compete With Germany in Certain Lines of Chemical Industries." Dr. Morgan said in part:

(1) The common people had no interest in the chemical industry until it was brought home to them by the laundries notifying them that they would not guarantee colors sent them. Then arose a clamor through the public press asking the reason for such a state of affairs.

(2) The chemical manufacturing industry in the United States amounts to about $500,000,000 annually.

(3) The German dye industry amounts to $80,000,000 annually, with a profit of 22 per cent.

(4) Many private businesses in the United States exceed this amount, such as the 5-10-15-cent stores, Ford Automobile Company, Sears-Roebuck Co., etc.

(5) Many chemical industries have been developed here in the United States, so there is plenty of ability if conditions are O. K.

(6) The larger industries which use chemicals and have been developed successfully are aluminum, calcium carbide, carborundum, graphite, emery, steel, oil, beef packing, cottonseed oil, etc.

(7) Now, why are there on dyes produced? The answer is that the large textile industries caused the tariff to be so placed that it caused them to go out of business as they could not compete against German competition. The German dye manufacturers were organized and sold through one selling organization.

(8) Dyes were made in Albany, N. Y., in 1866, and eight other places grew up shortly afterwards, when a tariff of $1 per pound and an ad valorem of 35 per cent was in effect. In 1883 the duty of $1 per pound was taken off, the 35 per cent ad valorem being retained on a few, but mostly free. Then five establishments went out of business, leaving only four. The tariff was again amended downward in 1897, and again in 1910 when even 10 per cent duty was placed on the raw material imported for the industry.

(9) It was also stated that the German dyes were better but this is not so and has been proven so.

(10) There are approximately 900 dyes produced in the industry.

(11) Germany encouraged the industry until there are about 1100 different producers who pool their products. The reason for this encouragement is the fact that many of the by-products of the industry are used in the manufacture of ammunition.

(12) The actual cost of the dye in a blue serge suit of clothes to the manufacturer for a man is 5 cents, with a protective tariff of 7 cents.

(13) Since the war demands for dyes have arisen; 30 different dye establishments have been established in the United States.

(14) Germany also controls all the potassium salts produced.

(15) The manner of handling the tariff in regard to the dye industry illustrates the fact that experts and commissions should handle same and not the politicians.

(16) Germany illustrates this method of procedure in all her activities while the United States shows how ununited we are and how we suffer in comparison.

APPLICATIONS TO CALIFORNIA WATER COMMISSION.

The commission has received an application from W. L. Shaffer of Seneca, Plumas county, asking permission to appropriate 400 second feet of water from the North Fork of the Feather River for mining and milling purposes. The works contemplate a concrete and masonry dam, with ditch, pipe line and flume two miles in length. There is a total fall of 0 ft. vertically, which is figured to produce 3000 theoretical horsepower, to be developed at an electric plant. The works are to be located at Scott's Bar, 1½ miles below the point of intake and at Seneca Gold Mine Company's mine and Van Winkle mines, half a mile further down. The estimated cost of the improvements is $45,000.

E. R. Walker of 607 J street, Sacramento, has applied to the commission for permission to appropriate 200 second feet of water from the South Fork of the American River for agricultural purposes. The engineering data on the diversion works are not complete, neither has the estimated cost been determined, but the project is one of considerable magnitude, comprising a storage reservoir with capacity of 50,000 acre feet or 16,335,000,000 gallons, also a main canal some 35 miles in length. The lands to be irrigated are in Sacramento and Placer counties.

Some time ago, the Sespe Light & Power Company of Los Angeles, applied to the commission for permission to appropriate water for a project which contemplated among other things, the irrigation of some 30,000 acres of land in Ventura county. The company has now made a separate application for permission to appropriate 125 second feet for power purposes, namely the generation of electricity for commercial use. The application sets forth a proposed main canal and pipe line nine miles in length; a diversion dam 175 ft. high, 220 ft. on top and 75 ft. on bottom. The dam construction is of loose rock, concrete, masonry and rip-rap, with waste-way around dam. There is a storage reservoir of 57,750 acre feet or nearly 19,000,000,000 gallons. By a fall of approximately 1000 ft. it is proposed to generate about 3000 theoretical horsepower. The estimated cost of the Sespe project is $2,000,000.

Claudie A. Strabley of Dixieland, Imperial county has applied to the commission for permission to appropriate 150 miners' inches of the waters of Cariso Creek, a tributary of the San Felipe River. He intends to divert the water by means of a 26 h.p. pumping plant carrying the water by means of a ditch half a mile long to 160 acres of land at an estimated cost of $1200. H. L. Welch and Kate E. Oldham of El Centro are witnesses for applicant. Mr. Strabley also makes application for another diversion of 50 miners' inches from a nearby point. By means of a diversion dam and ditches at a cost of $800, he intends to carry additional water to the same lands.

A. S. Hinkley and W. H. Hawken of Modesto have been granted a permit by the commission to appropriate two second feet of the waters of Wilson Creek in Mono county, tributary to Mono Lake. By a fall of 440 ft., it is proposed to generate electricity to the extent of 100 theoretical horsepower. The plant proposes a tangential water wheel direct connected to an electric generator, which will supply heat, light and power to operate milling machinery. The commission has imposed a condition that the water, after its use for power, shall be returned to the creek by such conduit as will eliminate transmission loss. The estimated cost is $2500.

NEWS OF OREGON PUBLIC SERVICE COMMISSION.

The commission has set dates for hearings as follows: April 3, 10 a. m., Grants Pass, California-Oregon Power Company; April 4, 1 p. m., Medford, California-Oregon Power Company; April 5, 9 a. m., Medford, Home Telephone Company of Southern Oregon; April 7, Klamath Falls, 9 a. m., California-Oregon Power Company.

BOOKS REVIEWED.

"Hydraulic Tables," by Jos. H. Harper; 192 pp.; 4x6½ in.; leather bound. Published by D. Van Nostrand Company, New York City, and for sale by Technical Book Shop, San Francisco. Price $2.00.

This pocket book is avowedly a practical compilation and calculation of tables accurate enough to solve field problems in the flow of water in circular pipes under pressure, timber flumes, open channels and egg-shaped conduits. The tables are based upon the D'Arcy, Bazin and Kutter formulas, and are supplemented by comparative charts. The accuracy of these several formulas are discussed. A number of conversion tables are also given, together with a brief account of weir measurement. The book fills its purpose admirably, though not fitted for refined measurements or more technical uses.

"Irrigation Practice and Engineering," by B. A. Etcheverry; Vol. I, Use of Irrigation Water and Irrigation Practice; 213 pp.; 6x9 in. Price $2.00; Vol. II, Conveyance of Water; 364 pp.; 6x9 in. Price $3.50; Vol. III, Irrigation Structures; 438 pp.; 6x9 in. Price $4.00. Published by McGraw-Hill Book Co., New York, and for sale by Technical Book Shop, San Francisco.

The plan of publishing this complete treatise on all phases of the subject in three volumes is one to be commended, as thereby the reader can find the information of use to himself in a book of convenient size, instead of in an unwieldly volume of over one thousand pages. The author is head of the Department of Irrigation at the University of California, and unusually well qualified to write upon the subject. The three volumes admirably fill the needs of teachers and students in technical colleges and form a valuable reference work for engineers, managers and superintendents of irrigation systems.

The first volume is, in a measure, introductory, and treats of the best methods of utilizing available water. The conservation of soil moisture and its effect on plant growth is recounted in detail, with special reference to water requirement of various crops, approved time to irrigate, duty of water, preparation of land and distribution of water. The concluding chapter deals with the selection and cost of a small pumping plant. It contains matters of value to the irrigator.

The second and third volumes are written for the engineer. The one is concerned with preliminary investigations, locations, computations, conduit design and construction to minimize silt and seepage (including canals, flumes, tunnels, metal and concrete pipes) and special consideration of inverted siphons and auxiliary works. The other deals with diversion works, head-gates, the various details of main and lateral canals, crossings, special types of distribution systems and measuring devices. Numerous illustrations of current practice are given with comments thereon, so that the treatise, as a whole, is the most comprehensive yet published on this subject, which is of special interest to Western engineers and power companies.

"The Diesel Engine in Practice," by J. E. Megson and H. S. Jones; 136 pp.; 4½x6½ in.; leather bound. Published and for sale by Technical Publishing Co., San Francisco. Price $2.00.

This is essentially a book for the use and instruction of plant engineers. The authors have drawn from a wide practical experience and brought into compact form much that is necessary to guide in the selection, installation and operation of Diesel engines for stationary and marine purposes. After a brief historical introduction and account of experience with early installations, due consideration is given to the fuel oil question and the effect of altitude. A large section is devoted to the care and operation of engines in general, with special reference to various types. The life and reliability is thoroughly discussed. Complete illustrated descriptions are given of all makes of modern engines in commercial use and under the general title of commercial conditions complete comparative analyses of costs are given.

NEWS NOTES

ILLUMINATION.

TEMPE, ARIZ.—The city is considering the installation of a municipal lighting plant.

PARLIER, CAL.—At a recent election held here the proposition to form a lighting district carried.

FRESNO, CAL.—April 18th has been set as the date for holding the Del Rey lighting district election.

MERCED, CAL.—A petition from Atwater asking for a lighting district, was filed by the county supervisors.

CHICO, CAL.—Light and power will be furnished the Paradise section by the Pacific Gas & Electric Company's extension out of De Sabla.

EVERETT, WASH.—J. L. Fountain, 506 Twelfth Ave. N. E., Seattle, is interested in the construction of a hydroelectric plant in the Sauk River.

BAKERSFIELD, CAL.—An electrolier lighting system for Bakersfield similar to the new one in Fresno was suggested in a report recently submitted to the Chamber of Commerce recently.

FRESNO, CAL.—The trustees have awarded the contract for the construction of an electrolier street lighting system upon each side of J street from Merced to Tuolumne and on Tuolumne street from J to I streets, to the Central State Electrical Company for $1278.

CLOVIS, N. M.—A resolution has been passed by the city council providing that an election be held on April 4th to vote on bonds in the sum of $35,000 for the purpose of securing the funds for the extension and improvement of the water, sewer and electric light systems.

ALAMOGORDO, N. M.—The town of Alamogordo has made a contract to purchase the properties of the Alamogordo Improvement Company, Water Works and Light & Power Company for $300,000. This contract will be submitted at an election on April 4th, when the matter of a bond issue for that amount will be decided.

LOS ANGELES, CAL.—That the city has signed light and power contracts with 60 per cent of the consumers in the district north of East Main street and east of the river is made known by E. F. Scattergood, chief engineer of the power bureau. The district includes East Los Angeles, Garvanza and Highland Park. It is served by the Pacific Light & Power Company and was selected by the Public Service Commission for a beginning in a local distributing system, so that if the Edison system should be taken over there would be no duplication of city lines. The contracts do not stipulate a definite time for the beginning of delivery of light and power, but the price is fixed at 10 per cent below the present rates.

TRANSMISSION.

FILLMORE, CAL.—Arrangements have been completed whereby the Ventura County Power Company will install a system to distribute electricity in the Bardsdale community.

BAKERSFIELD, CAL.—The board of supervisors has granted a franchise to the Pacific Light & Power corporation to construct an electrical distribution system over certain public highways in Kern county.

COULEE CITY, WASH.—An ordinance has been passed by the council providing for the construction and operation by the Grant County Power Company of a pole and conduit system for the transmission of electric power and light.

CHELAN, WASH.—Those in close touch with the Great Northern Railway Company here state that the railroad company is preparing to make a start this summer on the construction of their proposed huge hydroelectric power plant at Lake Chelan, which will involve an expenditure of over $3,000,000.

YREKA, CAL.—Plans are being made by the California-Oregon Power Company to extend its field of operations into Trinity county this spring. A ten-year contract has been made with the Yukon Gold Company to supply power for its dredging operations near Carrville, and arrangements are under way with another company to furnish a part of the power needed in its mining work. The new power line will be built into Trinity county by way of Lamoine, and construction work will be started soon. The line will be completed next fall or early winter, by the time the first dredger is ready for work.

TELEPHONE AND TELEGRAPH.

OROVILLE, CAL.—Permission has been granted Richvale residents to erect a telephone system.

RITZVILLE, WASH.—A farmers' telephone company is being organized which will operate a system of rural phones extending from a point four miles east of Cunningham to the county line.

WENATCHEE, WASH.—The forestry department will extend its telephone system in the Entiat and Chelan forests this summer. The line in the Stehekin District will be improved and new lines built on the Chellin and Entiat watershed.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Pacific Telephone & Telegraph Company directors were re-elected as follows: Louis Glass, F. W. Eaton, Chas. J. Deering, A. B. Cooper, S. Waldo Coleman. The directors re-elected the following officers: Louis Glass, president; F. W. Eaton, and S. Waldo Coleman, vice-presidents; Chas. J. Deering, treasurer, and H. W. Smith, Secretary.

WATERWORKS.

HARLOWTOWN, MONT.—The city has voted $15,000 to extend and improve the water system.

LOVELOCK, NEV.—A bond issue of $80,000 was recently voted for the installation of a new water system for the town of Lovelock.

HONOLULU, T. H.—The total cost to taxpayers of Honolulu for installing a complete system of water meters throughout the municipality is estimated at $83,765.

SANTA MARIA, CAL.—The bid of the Anglo-London Paris Bank of San Francisco for $75,000 worth of water bonds recently voted has been accepted by the city trustees.

TACOMA, WASH.—On the recommendation of Commissioner Drake the council has voted to extend the Mullen franchise under which the Tacoma Water Supply Company is serving North End residents.

SANDPOINT, IDAHO.—The committee appointed by Mayor Himes to investigate the practicability of Sandpoint building or purchasing a municipal water plant reported in favor of the employment of an expert engineer in gathering data before taking definite action.

CANBY, ORE.—In a report submitted by Engineer Cobb of Oregon City who has surveyed and appraised the waterworks system owned by Mr. Lee, he placed a valuation of approximately $5000 upon the plant, and estimated that a new system could be built for $18,000.

SEATTLE, WASH.—Plans have been completed by the city engineer's office for the construction of an auxiliary water and fire protection system for the Rainier Beach District to cost $30,000. Plans call for the construction of a steel water tower 119 ft. high, and a steel tank 46 ft. in diameter. Bids for the work will be called at once.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co.. 4
Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co.....
673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co.....
590 Howard St., San Francisco.

B-5 Bridgeport Brass Co..... 3
(See Pierson, Roeding & Co.)

C-1 Century Electric Co..... 12
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co.....
Crossley Bldg., 613 Mission St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 5
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... 4
Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 11
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 11
441 Golden Gate Ave., San Francisco.

E-3 Electric Agencies Co.....
247 Minna Street, San Francisco; Central Building, Los Angeles.

Electric Novelty Works..... 5
533 Mission Street, San Francisco, Cal.

E-4 Electric Storage Battery Co.....
Pacific Electric Bldg., Los Angeles; Spalding Bldg., Portland; 118 New Montgomery St., San Francisco; Colman Bldg., Seattle.

E-5 Electric, Railway & Manufacturing Supply Co..... 11
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co..... 5
Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric).....
618 Mission St., San Francisco.

G-1 General Electric Co..... 10
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co.....
1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Wire Co.....
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 11
330 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-5 Hunt, Mirk & Co.....
141 Second St., San Francisco.

H-7 Hurley Machine Co..... 2
New York and Chicago.

I-1 Indiana Rubber and Insulated Wire Co..... 12
Fobes Supply Co., Portland and Seattle.

I-2 Illinois Electric Co.....
261-263 So. Los Angeles St., Los Angeles.

L-1 Leahy Manufacturing Co..... 5
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 4
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... 5
Sunnyvale, Cal.

M-4 Morse Chain Co.....
Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N.....
151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... 4
Cleveland, Ohio.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co.....
(All Jobbers.)

N-4 New York Insulated Wire Co.....
629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad.....
808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 12
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co.....
80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 90 Seventh St., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 11
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 3-4
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 Pittsburgh Piping & Equipment Co..... 12
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The.....
211 J St., Sacramento; 356 Market St., San Francisco.

S-3 Simplex Electric Heating Co..... 12
612 Howard St., San Francisco.

S-4 Southern Pacific Co..... 4
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 3
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland; Central Bldg., Seattle, Wash.

T-1 Thomas & Co., R.....
(See Western Electric Co.)

T-2 Tubular Woven Fabric Company.....
Pawtucket, R I.

W-2 Western Electric Co.....
Eighth and Santee Sts., Los Angeles; 1901 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-4 Westinghouse Electric and Manufacturing Co..... 6
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 Westinghouse Machine Co.....
141 Second St., San Francisco.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles.